PROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON
108(4):687–694. 1995

Gobiodon acicularis, a new species of gobioid fish (Teleostei: Gobiidae) from Belau, Micronesia

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Abstract.—A new species of gobiid, *Gobiodon acicularis,* bearing an unusual, highly elongate first dorsal spine, is described. Other distinguishing characters, in combination, include lack of post-symphysial canine teeth in the lower jaw, high number of papillae on the dorsum, overall uniform pigmentation of head, body and fins, lack of an interopercle-isthmus groove and a narrow gill opening. The material forming the basis of the description was collected in Belau (Palau) in the 1950's. Available habitat data indicate that the species occurs in reef margin or lagoonal habitats.

The Indo-Pacific genus *Gobiodon* Bleeker, 1856, is a group of gobies that live as adults as obligate associates of corals of the genus *Acropora* (Patton 1994). The species, which reach up to about 40 mm SL, are characterized by a scaleless body covered by a thick mucus layer, a reduced head papillae pattern, and generally small jaw teeth with the exception of one or two pairs of well-developed canine teeth posterior to the dentary symphysis. *Gobiodon* appears to share with another hermaphroditic goby genus, *Paragobiodon,* an unusual and probably derived gonad structure (Cole 1990). *Pseudogobiodon* Bleeker, 1874, is similar to *Gobiodon* but the post-symphysial canine teeth are lacking in the only known species, *P. macrochir* Bleeker, 1875 (*Gobius citrinus* Rüppell, 1838, was erroneously ascribed to *Pseudogobiodon,* as the type species, by Bleeker 1874:309). Whether or not species lacking these canine teeth should be considered generically distinct from *Gobiodon* is a phylogenetic problem we hope to solve in the near future.

Many of the described species are brightly colored, often with distinctive body bars, spots and/or fin striping (see, for example, Akihito 1984:265–266, plate 246, F–P). *Gobiodon* has attracted considerable attention from systematists, resulting in more than 30 nominal species that can be attributed to it. Of these described species we currently recognize 14 as valid: *G. albofasciatus* Sawada & Arai, 1972; *G. axillaris* De Viz, 1884; *G. ceramensis* (Bleeker, 1852); *G. citrinus* (Rüppell, 1838); *G. fulvus* Herre, 1927; *G. heterospilos* Bleeker, 1856; *G. histrio* (Valenciennes, 1837); *G. micropus* Günther, 1861; *G. oculolineatus* Wu, 1979; *G. okinawae* Sawada et al., 1972; *G. quinquestrigatus* (Valenciennes, 1837); *G. reticulatus* Playfair, 1867; *G. rivulatus* (Rüppell, 1830) (not of Suzuki et al. 1995); and *G. unicolor* (Castelnau, 1873).

During our survey of collections of *Gobiodon* from throughout the Indo-Pacific region we found the present undescribed species in the collection of the California Academy of Sciences. Since this species so clearly differs from all other congeners, we have decided to describe it now, making its name available for other, planned papers on the genus.

Materials and Methods

Determination of meristic character values follows Hubbs & Lagler (1947), with

exceptions given below. Osteological characters determined from three paratypes (ROM 1603CS, 27.2 mm SL ♂ and 31.3 mm SL ♀; CAS 81515, 34.0 mm SL ♀) cleared and stained following the method outlined by Potthoff (1984). Vertebral and caudal-fin ray counts were taken from radiographs. The last branched ray of the dorsal and anal fins is divided to its base and is counted as a single element. Caudal-fin ray counts are given as the number of segmented and unsegmented rays, as opposed to procurrent and principal rays (see Hoese & Gill 1993:419), and the number of unbranched and branched rays. First dorsal-fin pterygiophore formula follows Birdsong et al. (1988:175). Terminology for lateralis pores follows Lachner & Karnella (1980): AI, anterior interorbital; AO, anterior otic; IT, intertemporal; NA, nasal; PI, posterior interorbital; POP, preopercular; SO, superior otic. Meristic data are reported as the range with the value for the holotype underlined, followed, in parentheses, by the mean and number of specimens counted. Institutional abbreviations follow Leviton et al. (1985).

Morphometric measurements were made to the nearest 0.1 mm using digital calipers interfaced by a Smartcable (Gage Connections, Inc.) with the software DATAQ, version 1.02 (D. L. Schultz). Data were analyzed for univariate statistics using SAS (SAS Institute Inc.) for personal computers, version 6. Standard length (SL) was measured from the median point of the premaxillary groove (anteriormost point of snout) to midlateral base of caudal fin. Head length (HL) was measured from the snout tip to posteriormost position on opercular membrane. The following measurements are reported as percentages of either HL (measurements of the head) or SL (all others): snout to origin of first dorsal fin; origin of first dorsal fin to origin of second dorsal fin; origin of second dorsal fin to origin of anal fin; anterior base of pelvic spine (pelvic-fin origin) to origin of anal fin; snout to pelvic-fin origin; origin of first dorsal fin to pelvic-fin origin; origin of first dorsal fin to origin of anal fin; anterior base of pelvic spine to origin of second dorsal fin; pelvic-fin length, pelvic-fin origin to tip of longest ray; anal-fin length, anterior base of third branched ray to its tip; first dorsal-fin first spine length, anterior base of first spine of first dorsal fin to its tip; first dorsal-fin sixth spine length, anterior base of sixth spine of first dorsal fin to its tip; second dorsal-fin length, anterior base of first branched ray of second dorsal fin to its tip; pectoral-fin length, base of longest ray of pectoral fin to its tip; caudal peduncle length, anterior base of central caudal rays to posterior base of last ray (insertion) of anal fin; caudal-peduncle depth, insertion of last ray of second dorsal fin to insertion of last ray of anal fin; orbit diameter, the maximum diameter in horizontal plane; snout length, minimum distance from anterior margin of orbit to tip of snout; interorbit (bony), minimum distance between orbits.

Gobiodon acicularis, new species
Figs. 1, 2, Table 1

Holotype.—CAS 81525 (31.4 mm SL), western Pacific Ocean, Belau (Palau), off Babelthuap Island, coral-enclosed area north of Arakataoch Stream, collected by H. A. Fehlmann et al., 22 Sep 1957.

Paratypes.—CAS 81515 (5, 30.1–34.3 mm SL), western Pacific Ocean, Belau (Palau), north shore of Korer Island, reef bordering eel-grass flat east of Ebadel's Pier (T-dock), collected by R. R. Harry et al., 4 Aug 1955; CAS 81522 (6, 31.0–39.1 mm SL), western Pacific Ocean, Belau (Palau), Auluptagel Island in Ngarahelngael Pass, ca. 45 meters north of Ngarahelngael, collected by H. A. Fehlmann et al., 9 Oct 1957; CAS 82377 (5, 21.5–30.4 mm SL), ROM 1603CS (2, 27.2–31.3 mm SL, CS), collected with holotype; ROM 69038 (2, 33.1–36.6 mm SL), collected with CAS 81522.

Diagnosis.—A species of *Gobiodon* that is distinguished by a derived, highly elon-

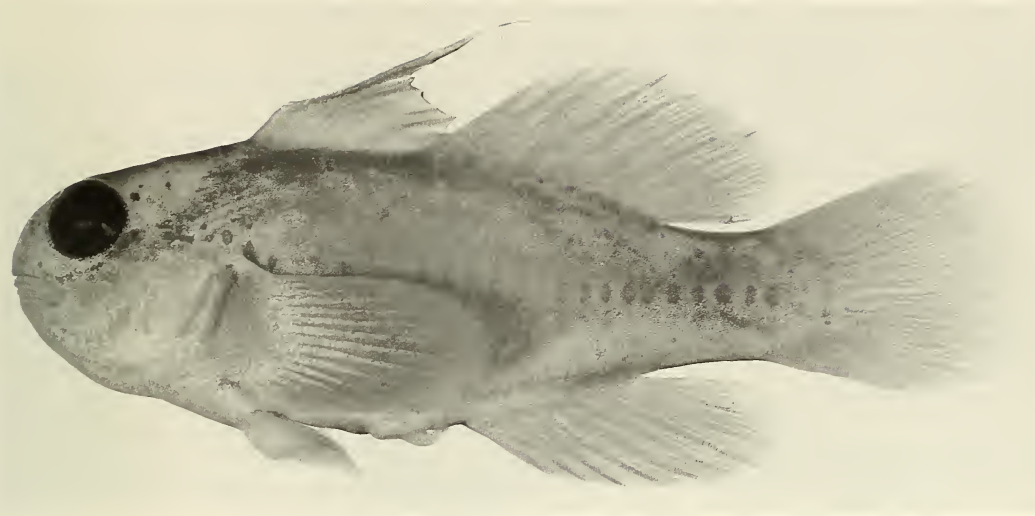

Fig. 1. *Gobiodon acicularis,* lateral view, left side (holotype, CAS 81525, 31.4 mm SL).

gate (18.7–50.7 % SL) spine I of the first dorsal fin and, in combination, by lack of post-symphysial canine teeth in the lower jaw, spines of first dorsal fin decreasing in length progressively from anterior to posterior, subequal upper jaw teeth (i.e., outer teeth not prominently enlarged), an absence of stripes or other markings, 16 or 17 pectoral-fin rays, more than four papillae in the anterior predorsal group and lack of an interopercle-isthmus groove.

Description.—Dorsal-fin rays VI + I, 10–11 ($\bar{X}$ = 10.2, n = 16), first spine filamentous and highly elongate (Fig. 1), its relative length variable but not varying by sex or body size, in some specimens length of the spine reaching one half of standard length (Table 1); spines of first dorsal fin decreasing sequentially in length posteriorly; a shallow notch present between dorsal fins; first dorsal-fin pterygiophore formula 3-22110; second dorsal-fin posterior rays elongate, in some specimens reaching posteriorly as far as bases of dorsal segmented caudal-fin rays; anal-fin rays I, 9 in all specimens, posterior rays elongate, reaching bases of segmented caudal-fin rays as with second dorsal fin; pectoral-fin rays 16–17 ($\bar{X}$ = 16.1, n = 20), fin extending posteriorly as far as second or third branched anal-fin ray in some specimens; pelvic-fin rays I,5 in all specimens; pelvic-fin fraenum and basal membrane complete, fin relatively large, usually reaching as far as anus and occasionally base of genital papilla; segmented caudal-fin rays 9 + 8, dorsal unsegmented rays 5–6 ($\bar{X}$ = 5.6, n = 11), ventral unsegmented rays 5–6 ($\bar{X}$ = 5.7, n = 11); dorsal branched caudal-fin rays 8–9 ($\bar{X}$ = 8.3, n = 11); ventral branched caudal-fin rays 7–8 ($\bar{X}$ = 7.2, n = 11); scales absent; first gill slit open; gill opening restricted, ending ventrally opposite bases of pectoral-fin ray 11–14–16 ($\bar{X}$ = 13.5, n = 19); gill rakers, short, basally ossified 1 + 2, 1 + 4, 2 + 5 (n = 3); mouth small, terminal, gape extending posteriorly to below anterior one-half of eye; upper jaw teeth subequal, small, conical to slightly recurved, arranged in 2 to 3 irregular rows; lower jaw teeth similar to those of upper jaw, post-symphysial canine teeth absent; anterior nasal opening at tip of long fleshy tube, posterior nasal opening with raised rim or short tube; anterior oculoscapular canal pores 6 (NA, AI, PI, SO, AO, IT) (Fig. 2); preopercular canal pores 3; head papillae in a reduced transverse pattern (Fig. 2), with suborbital row

Table 1.—Morphometric characters of *Gobiodon acicularis,* based on the holotype, CAS 81525, and 19 paratypes, CAS 81515, CAS 81522, CAS 82377, ROM 69038 and ROM 1603CS, all from Belau. Standard length in mm; interorbital width, horizontal eye diameter, snout length and upper jaw length as percentages of head length; all other morphometric characters as percentages of standard length.

	Holotype	Range	$\bar{X}$
Standard length	31.4	21.5–39.1	31.0
Snout to first dorsal–fin origin	34.4	33.1–39.2	35.7
First dorsal–fin origin to second dorsal–fin origin	23.9	21.0–26.7	23.4
Second dorsal–fin origin to anal–fin origin	34.4	33.5–40.7	36.6
Pelvic–fin origin to anal–fin origin	27.7	25.9-35.5	30.0
Snout to pelvic–fin origin	33.4	33.0–40.1	35.4
First dorsal–fin origin to pelvic–fin origin	35.7	35.6–42.1	38.3
First dorsal–fin origin to anal–fin origin	43.6	43.6–51.7	46.7
Pelvic–fin origin to second dorsal–fin origin	42.0	40.1–49.1	44.4
Pelvic–fin length	16.9	16.9–23.3	18.7
Anal–fin length	19.7	18.4–28.4	22.2
First dorsal–fin first spine length	36.6	18.6–50.7	38.3
First dorsal–fin sixth spine length	13.6	8.0–16.3	12.5
Second dorsal–fin length	19.4	15.2–24.5	18.8
Pectoral–fin length	31.8	29.4–38.6	34.4
Caudal–peduncle length	24.8	22.0–25.3	23.9
Caudal–peduncle depth	18.8	17.6–20.8	19.3
Head length	26.8	26.0–30.3	28.3
Interorbital width	22.6	15.1–23.6	19.2
Horizontal eye diameter	10.2	7.9–11.4	9.6
Snout length	27.4	23.3–30.3	27.0
Upper jaw length	30.9	27.1–34.5	30.2

6–7–8 ($\bar{X}$ = 7.6, n = 14), dorsal preopercular row 6–7–9 ($\bar{X}$ = 7.1, n = 14) and ventral preopercular row 4–7–8 ($\bar{X}$ = 6.9, n = 14); two clusters of papillae on predorsal surface (Fig. 2), anterior cluster 1 + 1–2–3, posterior cluster 1–2 + 1 with anterior papilla in cluster located anteriorly or anterolaterally to posterior papilla; tongue rounded; no groove present between interopercle and isthmus; branchiostegal rays 5; vertebrae 10 + 15 + ural centrum = 26; epurals 1; morphometric values given in Table 1.

Color in alcohol (all material preserved in 55 % isopropyl alcohol).—Head and body covered nearly uniformly with small, pale brown chromatophores, except on posterior margin of gill membrane where they are slightly larger and darker; all fins with many scattered, small chromatophores similar to those of body; pectoral fin and distal margin of first dorsal fin distinctly darker than other fins and body; no stripes or other markings present.

Etymology.—The name is based on the Latin adjective *acicularis,* meaning like a needle, in reference to the elongate spine I of the first dorsal fin.

Remarks.—Gobiodon acicularis is distinguished from all other described congeners by its highly elongate first spine of the first dorsal fin. In other respects the new species resembles *G. ceramensis* (Bleeker, 1852) and the adults, according to a manuscript key (D. F. Hoese, pers. comm.), of *G. albofasciatus* Sawada & Arai, 1972 with which it shares relatively uniform body pigmentation without markings, lack of a groove between the interopercle and isthmus, and the outer row of the upper jaw teeth not prominently enlarged. Both of these species share with *G. acicularis* the possibly derived first dorsal fin shape with the lengths of the spines decreasing progressively from anterior to posterior. Unlike *G. acicularis, G. albofasciatus* has a relatively broad gill opening, occupying nearly the entire base of the pectoral fin. The gill opening of *G. acicularis* is quite narrow, terminating ventrally at the level of the base of the 14th to 16th pectoral-fin ray. *Gobiodon citrinus* is also similar to the above species in the shape of the first dorsal fin, but has prominent transverse stripes on the head and body posterior to the pectoral-fin base and a dusky spot at the dorsal margin of the gill opening. This species is further distinguished by its relatively small pelvic fin and narrower gill opening.

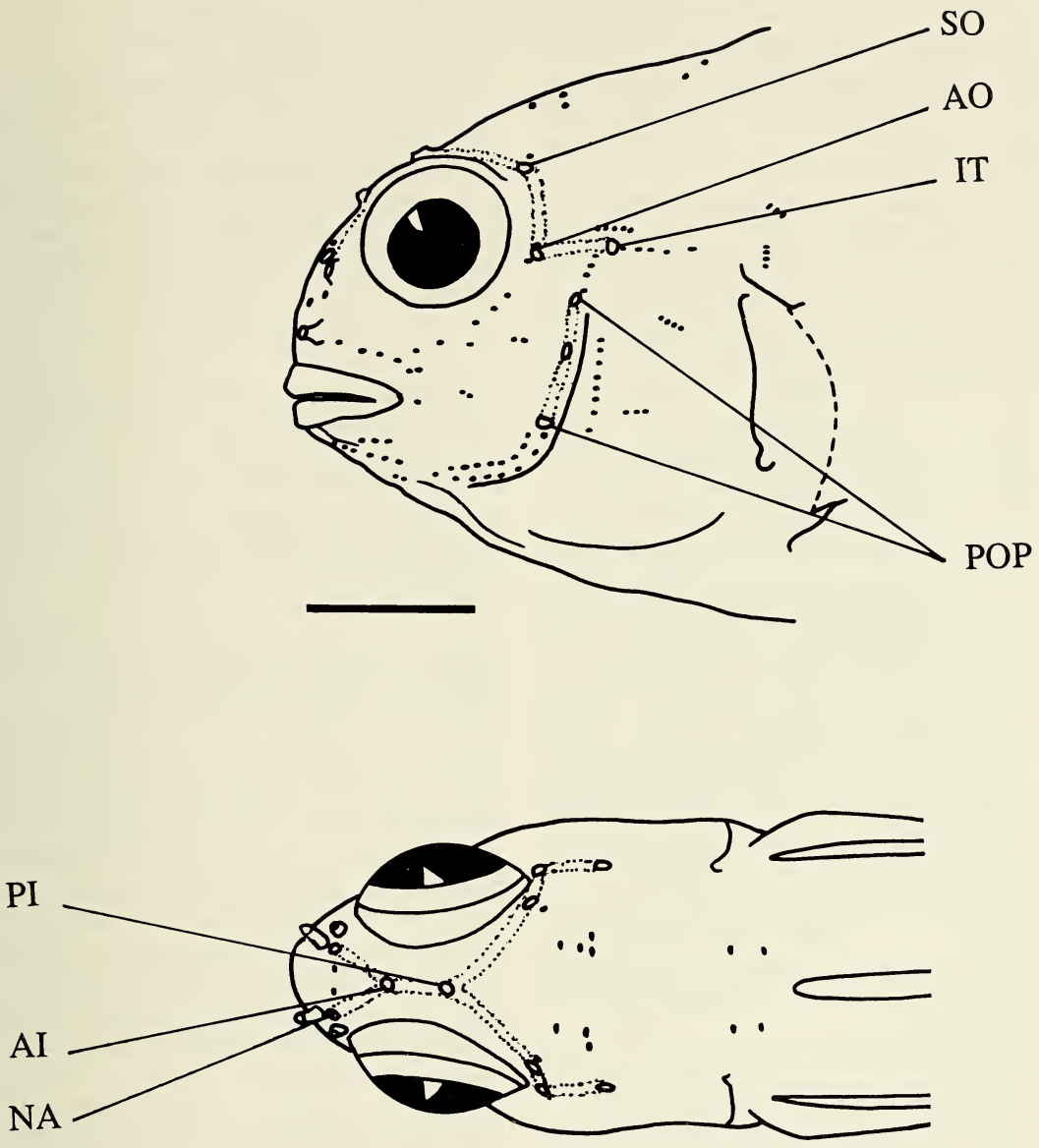

Fig. 2. Head of *Gobiodon acicularis* (paratype, CAS 82377, 26.3 mm SL) showing arrangement of papillae and lateralis pores in left lateral (above) and dorsal (below) views. Abbreviations for lateralis pores, following Lachner and Karnella (1980): AI, anterior interorbital; AO, anterior otic; IT, intertemporal; NA, nasal; PI, posterior interorbital; POP, preopercular; SO, superior otic. Scale bar = 3 mm.

The morphology of *Pseudogobiodon macrochir* Bleeker, 1875 also bears some, possibly important, similarities to *G. acicularis.* Bleeker's erection of *Pseudogobiodon* for *P. macrochir* distinct from *Gobiodon,* was based on its slightly enlarged outer teeth of the upper jaw and, more importantly, the absence of post-symphysial canine teeth in the lower jaw. Neither of these characters are likely to be of use in diagnosing *Pseudogobiodon* based on observed variation within and between *Gobiodon*

species and the very small sample size upon which Bleeker's description was based (we only know of the holotype). *Pseudogobiodon* is almost never used in regional faunal works on Indo-Pacific fishes (see Koumans 1953:13, for example).

Our examination of the holotype of *P. macrochir* (RMNH 4463, 26.7 mm SL) reveals that the upper jaw teeth are subequal, as they are in *G. ceramensis* and *G. citrinus,* for example, a condition which is probably derived within *Gobiodon.* We confirm that the post-symphysial dentary canine teeth are absent in the holotype of *P. macrochir,* as described by Bleeker (1875). Post-symphysial canine teeth are absent in *G. acicularis,* variously present or absent in adults of another, probably undescribed, *Gobiodon* species and present, but reduced in size, in adults of *G. okinawae* (Sawada et al. 1972:59, fig. 2). Reduction of these canine teeth is probably derived and may support the monophyly of a clade. Pending results of our phylogenetic analysis, if such a clade, or *P. macrochir* alone, were found to be the sister group of a clade comprising all other *Gobiodon* species then the former could be referred to *Pseudogobiodon.* If, however, *P. macrochir* is found to be nonbasal in the *Gobiodon* clade then *Pseudogobiodon* should be synonymized with *Gobiodon* to preserve the monophyly of the latter genus.

Harrison (1989:348) indicated that some features of the skull of a species of *Gobiodon* (not identified to species) he examined were unique among gobioids and therefore likely derived. These characters are: (1) an enlarged supraoccipital crest with additional, paired crests anteriorly formed by dorsal extensions of the frontals along their medial surfaces, and (2) a deepened sphenotic and pterotic. These features are common to all species of *Gobiodon* we have examined, including *G. acicularis,* and to *Pseudogobiodon macrochir.* Given these shared, derived characters, *Gobiodon* can be provisionally diagnosed, whereas *Pseudogobiodon* cannot, and the former is therefore the appropriate genus for the new species.

Specific characters shared by *P. macrochir* and *G. acicularis* include a uniformly pigmented body with some fins, especially the first dorsal, noticeably darker than the body, lengths of the spines of the first dorsal fin decreasing progressively from anterior to posterior, and modally 16 pectoral-fin rays. Bleeker (1875:117) does not mention a horizontal stripe at the base of the second dorsal fin in *P. macrochir,* nor is one shown in the recently published illustration (Bleeker 1983: pl. 431, fig. 4). However, we have found there to be a lightly pigmented stripe along the base of each dorsal fin in the holotype of *P. macrochir,* indicating an important difference in pigmentation from *G. acicularis.*

Gobiodon acicularis is known only from the collections reported here from Belau. That the species is recognized now for the first time in spite of there being many collections of *Gobiodon* from reefs throughout the Indo-Pacific, including Belau (Randall, pers. comm.), is possibly explained by a restricted geographic distribution and/or what we know of its ecology so far. Collections from Belau were all made in back-reef areas where there may have been less collecting effort than at other locations where *Gobiodon* species occur. We have no information on host corals that might have been present, but given the general water conditions it is likely that *G. acicularis* occupies an unusual, probably derived, habitat with respect to congeners (see, for example, Patton 1994), which, as adults, are commensal primarily on *Acropora* species. New collections with detailed habitat data would be invaluable, if not essential, in our attempt to trace the evolution of host-commensal relationships in the genus.

Acknowledgments

We are grateful to W. Eschmeyer, D. Catania and J. Fong, CAS, who made the material available for this study, and to E. O.

Murdy and J. T. Williams for their helpful comments on the manuscript. Thanks are also due M. Rouse and C. Gilmore, ROM, for their technical assistance with radiography and B. Boyle for photography. Financial support for this study was provided through Natural Sciences and Engineering Research council of Canada operating grant A 7619 to RW.

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